



MEMORANDUM

To: Town of Parker Fire
Randy Capra
Senior Inspector
20120 E. Mainstreet
Parker, CO 80138-7335
303.805.3169

From: Jessica McCallum, P.E.
2 North Nevada Avenue
Suite 300
Colorado Springs, CO 80903

Date: September 27, 2021

Subject: McDonald's Chambers – Thrust Block Calculations

Town of Parker Fire has requested calculations justifying the sizing of the thrust blocks associated with the fire lines for the McDonald's Chambers project in Parker, CO. We recommend adherence to the Standard Details prepared by the Parker Water and Sanitation District with modifications as shown on the attached redlined Kickblock Block Detail. The following information is provided to support the use of these standards:

- Utility Plans
- Parker Water and Sanitation District Kickblock Detail
- Soil Bearing Pressure from Terracon's Geotechnical report for Project
- Thrust Block Calculations

The thrust blocks are designed to support a 150 psi internal pipe pressure. Allowable soil bearing capacity was determined from the National Engineering Handbook, Section 636.5207, table 52-6. Soil material was determined from the Geotechnical Evaluation for Parker and Pine Retail, completed by Ninyo & Moore dated April 4, 2019. The following table summarizes the calculated minimum bearing surface area per NFPA 24 criteria.

Thrust Block	Min. Bearing Surface Area per Parker Water & Sanitation District Details	Min. Bearing Surface Area per NFPA 24
Typ. 6" Water Line		
11.25° Bend	1.00 SF	0.59 SF
45° Bend	2.25 SF	4.06 SF
Tee or Dead End	3.00 SF	4.01 SF

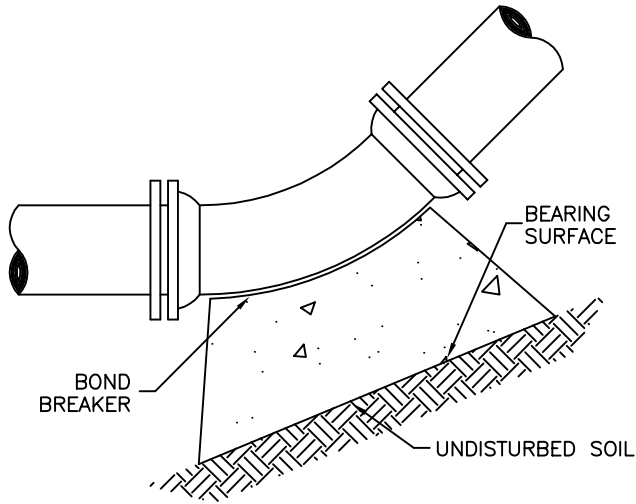
As identified above, the thrust block details for Parker Water and Sanitation District for the 45-degree and tee or dead end will need to be modified to meet the minimum theoretical block volume required by NFPA 24 and the Town of Parker.

A modified thrust block detail is included with this letter.

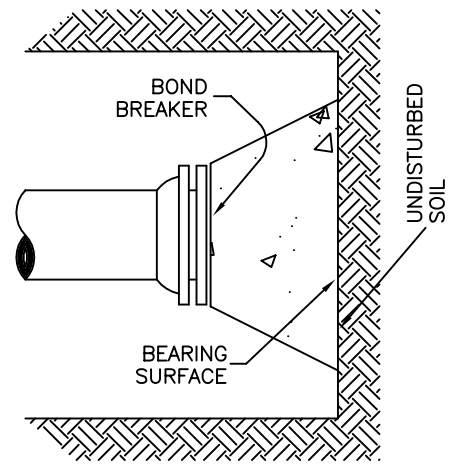
Please let me know if there are any questions.

KIMLEY-HORN AND ASSOCIATES, INC.

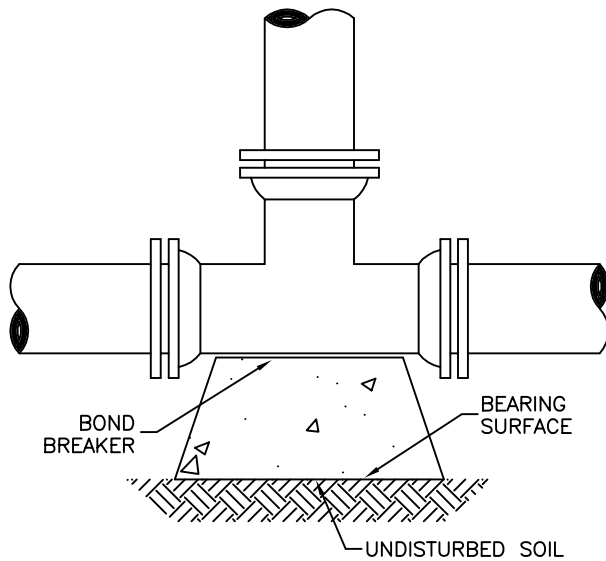
By: Jessica McCallum, P.E.
CO P.E. License No. 59054



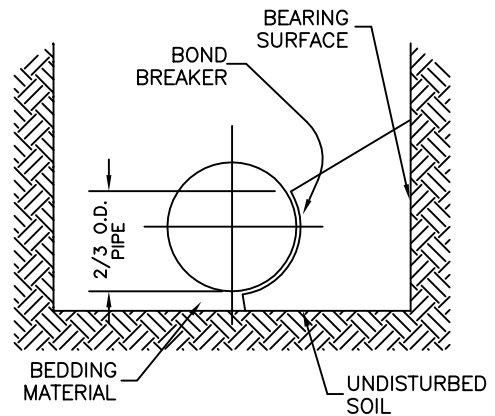
11-1/4°, 22-1/2°, 45° & 90° BENDS



DEAD END



TEE



TYPICAL CROSS SECTION

MINIMUM BEARING SURFACE AREA
(IN SQUARE FEET)

SIZE OF PIPE	BENDS				TEE OR DEAD END
	11-1/4°	22-1/2°	45°	90°	
4"	1.00	1.00	1.00	1.80	1.50
6"	1.00	1.25	2.25	4.00	3.00
8"	1.00	2.00	4.00	7.50	5.25
12"	2.00	4.25	8.25	15.25	11.00
16"	3.50	6.50	12.50	23.00	16.50
20"	5.00	10.00	19.50	35.50	25.00
24"	6.50	13.00	26.00	47.00	33.00

NOTES:

1. ALL VALVES, TEES, BENDS AND PLUGS SHALL BE RESTRAINED AND KICKBLOCKED.
2. BEARING SURFACES SHOWN IN CHART ARE MINIMUM.
3. BASED ON 150 PSI PIPE PRESSURE PLUS WATER HAMMER:
 4", 6" AND 8" WATER HAMMER = 120 PSI.
 12" WATER HAMMER = 110 PSI
 16", 20" AND 24" WATER HAMMER = 70 PSI.

MINIMUM BEARING SURFACE AREA		
Size	45° Bend	Dead End/TEE
6"	4.06	4.01

PARKER WATER & SANITATION DISTRICT
 CONCRETE KICKBLOCKS
 BEARING SURFACES AND INSTALLATION

SCALE: NONE	DATE: 2/96
APPROVED: PVR DIRECTOR OF ENGINEERING	4/01 1/16 10/16

CONCRETE THRUST BLOCK DESIGN

Project: McDonald's Chambers
 Designed by: Jessica McCallum, P.E.
 Dated: 9/21/2021

[A.10.6.1b]

$$b = \frac{2(S_f)(P)(A)\sin\left(\frac{\theta}{2}\right)}{(h)(S_h)}$$

where:

- b = calculated block width (ft)
- S_f = safety factor (usually 1.5 for thrust block design)
- P = water pressure (lb/in.²)
- A = cross-sectional area of pipe based on outside diameter
- h = block height (ft)
- S_h = horizontal bearing strength of soil (lb/ft²) (in.²)

Inputs

Safety Factor	1.5
Water Pressure (psi)	150
Inside Pipe Diameter (inches)	6
Cross section Area of Pipe Exterior (inches)	28.31
Deflection angle of pipe bend (degrees)	11.25
Block Height (ft)	1
Bearing Strength of Soil (lb/ft ²)(in ²)	2100
Calculated Block Width (ft)	0.59
Min. Bear Surface Area (ft ²)	0.59

Table 52-6 (of NEH Part 636.5207) - Allowable Soil Bearing Pressure				
Natural soil material	Depth of cover to center of thrust block			
	2 ft	3 ft	4 ft	5 ft
	lb/ft ²			
Sound Bedrock	8,000	10,000	10,000	10,000
Dense sand and gravel mixture (assumed $\theta=40^\circ$)	1,200	1,800	2,400	3,000
Dense fine to coarse sand (assumed $\theta=35^\circ$)	800	1,200	1,650	2,100
Silt and clay mixture (assumed $\theta=25^\circ$)	500	700	950	1,200

CONCRETE THRUST BLOCK DESIGN

Project: McDonald's Chambers
 Designed by: Jessica McCallum, P.E.
 Dated: 9/21/2021

[A.10.6.1b]

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where:

- b = calculated block width (ft)
- S_f = safety factor (usually 1.5 for thrust block design)
- P = water pressure (lb/in.²)
- A = cross-sectional area of pipe based on outside diameter
- h = block height (ft)
- S_h = horizontal bearing strength of soil (lb/ft²) (in.²)

Inputs

Safety Factor	1.5
Water Pressure (psi)	150
Inside Pipe Diameter (inches)	6
Cross section Area of Pipe Exterior (inches)	28.31
Deflection angle of pipe bend (degrees)	45
Block Height (ft)	1
Bearing Strength of Soil (lb/ft ²)(in ²)	1200
Calculated Block Width (ft)	4.06
Min. Bear Surface Area (ft ²)	4.06

Table 52-6 (of NEH Part 636.5207) - Allowable Soil Bearing Pressure				
Natural soil material	Depth of cover to center of thrust block			
	2 ft	3 ft	4 ft	5 ft
	lb/ft ²			
Sound Bedrock	8,000	10,000	10,000	10,000
Dense sand and gravel mixture (assumed $\theta=40^\circ$)	1,200	1,800	2,400	3,000
Dense fine to coarse sand (assumed $\theta=35^\circ$)	800	1,200	1,650	2,100
Silt and clay mixture (assumed $\theta=25^\circ$)	500	700	950	1,200

CONCRETE THRUST BLOCK DESIGN

Project: Parker and Pine Filing 1
 Designed by: Dan Skeehan, P.E.
 Dated: 3/31/2021

The required block area (A_b) is as follows:



[A.10.6.1a]

$$A_b = (h)(b) = \frac{T(S_f)}{S_b}$$

where:

- A_b = required block area (ft²)
- h = block height (ft)
- b = calculated block width (ft)
- T = thrust force (lbf)
- S_f = safety factor (usually 1.5)
- S_b = bearing strength (lb/ft²)

Inputs

Safety Factor	1.5
Water Pressure (psi)	150
Bearing Strength of Soil (lb/ft ²)(in ²)	2100
Thrust Force (lbf) for 100 PSI	3739
Calculated Thrust Force (lbf) for 150 PSI	5608.50
Min. Bear Surface Area (ft ²)	4.01

Natural soil material	Depth of cover to center of thrust block			
	2 ft	3 ft	4 ft	5 ft
	lb/ft ²			
Sound Bedrock	8,000	10,000	10,000	10,000
Dense sand and gravel mixture (assumed $\theta=40^\circ$)	1,200	1,800	2,400	3,000
Dense fine to coarse sand (assumed $\theta=35^\circ$)	800	1,200	1,650	2,100
Silt and clay mixture (assumed $\theta=25^\circ$)	500	700	950	1,200

N Table A.10.6.1(a) Thrust at Fittings at 100 psi (6.9 bar) Water Pressure for Ductile Iron and PVC Pipe

Nominal Pipe Diameter in. (mm)	Total Pounds (Newtons)											
	Dead End		90 Degree		45 Degree		22½ Degree		11¼ Degree		5⅝ Degree	
	lbf	N	lbf	N	lbf	N	lbf	N	lbf	N	lbf	N
4 (100)	1,810	8,051	2,559	11,383	1,385	6,161	706	3,140	355	1,579	162	721
6 (150)	3,739	16,632	5,288	23,522	2,862	12,731	1,459	6,490	733	3,261	334	1,486
8 (200)	6,433	28,615	9,097	40,465	4,923	21,899	2,510	11,165	1,261	5,609	575	2,558
10 (250)	9,677	43,045	13,685	60,874	7,406	32,944	3,776	16,796	1,897	8,438	865	3,848
12 (300)	13,685	60,874	19,353	86,086	10,474	46,591	5,340	23,753	2,683	11,935	1,224	5,445
14 (350)	18,385	81,781	26,001	115,658	14,072	62,595	7,174	31,912	3,604	16,031	1,644	7,313
16 (400)	23,779	105,774	33,628	149,585	18,199	80,953	9,278	41,271	4,661	20,733	2,126	9,457
18 (450)	29,865	132,846	42,235	187,871	22,858	101,677	11,653	51,835	5,855	26,044	2,670	11,877
20 (500)	36,644	163,001	51,822	230,516	28,046	124,755	14,298	63,601	7,183	31,952	3,277	14,577
24 (600)	52,279	232,548	73,934	328,875	40,013	177,987	20,398	90,735	10,249	45,590	4,675	20,795
30 (750)	80,425	357,748	113,738	505,932	61,554	273,806	31,380	139,585	15,766	70,131	7,191	31,987
36 (900)	115,209	512,475	162,931	724,753	88,177	392,231	44,952	199,956	22,585	100,463	10,302	45,826
42 (1,050)	155,528	691,823	219,950	978,386	119,036	529,498	60,684	269,936	30,489	135,622	13,907	61,861
48 (1,200)	202,683	901,579	286,637	1,275,024	155,127	690,039	79,083	351,779	39,733	176,741	18,124	80,620

Notes:

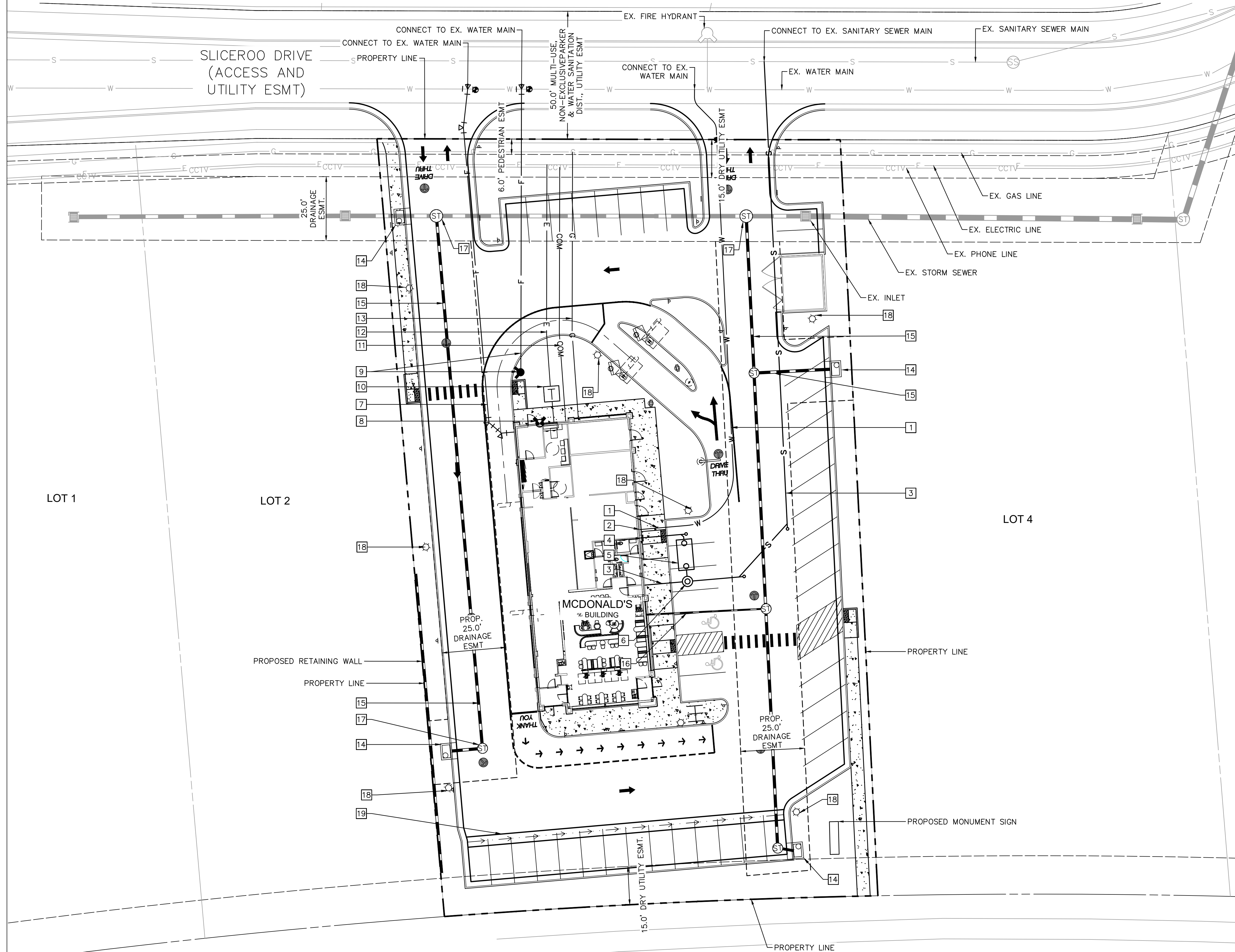
(1) For SI units, 1 lb = 0.454 kg; 1 in. = 25 mm.

(2) To determine thrust at pressure other than 100 psi (6.9 bar), multiply the thrust obtained in the table by the ratio of the pressure to 100 psi (6.9 bar). For example, the thrust on a 12 in. (305 mm), 90-degree bend at 125 psi (8.6 bar) is $19,353 \times 125/100 = 24,191$ lb (10,973 kg).

DOUGLAS 234 FILING NO. 6, LOT 3

A PORTION OF THE SOUTHEAST 1/4 OF THE SECTION 29,
TOWNSHIP 6 SOUTH, RANGE 66 WEST OF THE 6TH P.M.
TOWN OF PARKER, COUNTY OF DOUGLAS, STATE OF COLORADO

SITE PLAN

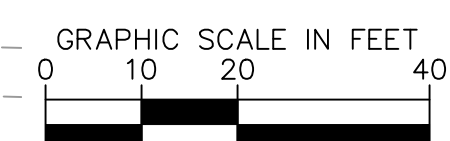
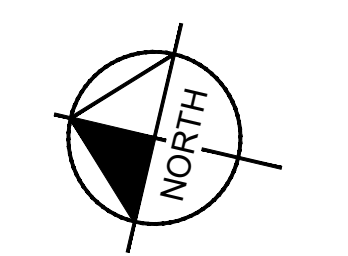


LEGEND

	PROPERTY LINE
	EASEMENT
	SCREEN WALL
	EX. WATER LINE
	EX. SANITARY LINE
	EX. STORM SEWER
	EX. PHONE LINE
	EX. ELECTRIC LINE
	EX. GAS LINE
	PROP. WATER LINE
	PROP. SANITARY LINE
	PROP. STORM SEWER
	PROP. PHONE LINE
	PROP. ELECTRIC LINE
	PROP. GAS LINE
	CONCRETE

KEY NOTES

- 1 PROPOSED DOMESTIC WATER SERVICE LINE
- 2 PROPOSED WATER METER LOCATED INSIDE BUILDING.
- 3 PROPOSED SANITARY SEWER SERVICE LINE
- 4 PROPOSED GREASE INTERCEPTOR SERVICE LINE
- 5 PROPOSED GREASE TRAP WITH TRAFFIC RATED LIDS
- 6 PROPOSED SAMPLING MANHOLE
- 7 PROPOSED FIRE SERVICE LINE
- 8 PROPOSED FDC
- 9 PROPOSED FIRE HYDRANT AND FIRE HYDRANT LATERAL
- 10 PROPOSED TRANSFORMER
- 11 PROPOSED TELECOMMUNICATIONS SERVICE LINE
- 12 PROPOSED ELECTRIC SERVICE LINE
- 13 PROPOSED GAS SERVICE LINE
- 14 PROPOSED STORM INLET
- 15 PROPOSED STORM SEWER
- 16 PROPOSED ROOF DRAIN
- 17 PROPOSED STORM MANHOLE
- 18 PROPOSED SITE LIGHT
- 19 PROPOSED 4" CONCRETE GUTTER PAN



TITLE	SITE PLAN	DATE	7/1/21
DESCRIPTION	PRELIMINARY UTILITY PLAN	REVIEWED BY	JRH
SITE ID	0050785	DATE ISSUED	9/3/2021
SITE ADDRESS	LOT 3, DOUGLAS 234 FILING NO. 6	REVISION 1	DATE
		DESCRIPTION	BY
			JJM
			BY

PREPARED FOR:
McDonald's USA, LLC
These drawings and specifications are the confidential and proprietary property of McDonald's USA, LLC and shall not be copied or reproduced without written authorization. The contract documents were prepared in reliance on the information provided in these drawings. Use of these drawings for reference or example on another project requires the approval of the engineer of record. Use of these drawings for any other purpose without the consent of the engineer of record is not authorized.

PREPARED BY:
Kimley-Horn
Kimley-Horn and Associates, Inc.

Kimley-Horn

REVISION 1	DATE
1	9/27/21
REV	DATE
DESCRIPTION	BY
	JJM
	BY